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ABSTRACT

Technological developments of the past decade have increased the potential of distance learning and telecommunications to help rural schools overcome disadvantages of remoteness, geographic isolation, lack of specialized staff, and limited program offerings. Classroom-focused distance learning is distance insensitive and involves transmission of a teacher's lessons from a host classroom to multiple receiving classrooms in distant locations. Network-focused distance learning, on the other hand, is both distance and time insensitive and involves use of electronic databases, electronic bulletin boards, or electronic mail. Classroom-focused distance technologies and applications include: (1) electronic field trips; (2) audiographics programs (one-way transmission of computer graphics plus two-way telephone communication); (3) interactive satellite television programs; and (4) two-way interactive television systems linking several schools. Network-focused services usually involve acquisition of information from large electronic databases or electronic bulletin boards, or communication among users via electronic mail. It is estimated that over 14,000 electronic databases are available to U.S. computer users, with over 5,000 available online. Databases and online services of particular interest to educators include ERIC (accessible via Internet), ERIC/CRESS Online, National Distance Learning Center Online, America Tomorrow Leadership Information Service, American Indian Science and Engineering Society Electronic Network, SpecialNet, CLASSMATE and Classroom Instruction Program (accessible through DIALOG), statewide networks, and government sponsored bulletin boards. The potential of Internet as a telecommunications resource for K-12 schools is discussed. (SV)

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AN OVERVIEW OF DISTANCE LEARNING AND TELECOMMUNICATIONS IN RURAL SCHOOLS

Paper presented at
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AN OVERVIEW OF DISTANCE LEARNING AND TELECOMMUNICATIONS IN RURAL SCHOOLS

Low student enrollments and geographical isolation of most rural schools have created unique challenges for educators hoping to provide rural youth with educational opportunities equal to students living in urban or metropolitan areas and attending large school systems. Depending on the data cited and definitions of "ruralness" used, America's rural schools enroll between 17 and 33 percent of all school aged children and comprise between 28 and 67 percent of all schools (Geiger, 1992; Lewis, 1991; Matthes and Carlson, 1987; U.S. Department of Education, 1991). Irrespective of exact figures or variance in definitions, rural schools typically face the multiple challenges of (1) limited course offerings for students; (2) providing high quality staff development opportunities for teachers who are usually geographically isolated from professional counterparts in other schools; (3) recruiting and retaining qualified teachers; (4) equitable funding for student program, teacher salaries, and capital improvements in comparison to urban and suburban districts; and (5) lack of specialized services (Cole, 1991; Jolly, 1993; Monk, 1989).

New Technologies Impacting Rural Schools

Today's young students -- whether they live in rural, urban, or metropolitan areas -- are growing up in the electronic age. They are getting much of their information from television, computers, video games, and other electronic devices. Rapid technological developments of the past decade have made possible an array of technological tools that can profoundly change today's classrooms. While schools in the mid-1980's were fortunate to have several computers for student use as well as teacher access to videocassette players/recorders (VCRs), if schools today are to be on the "cutting edge" of technology they should also have access to satellite links, telecommunications networks, electronic databases, and multimedia .

These advancing technologies have the potential to change the way students learn and the manner in which teachers teach. This is especially true of developments in distance learning and telecommunications -- particularly satellite, fiber optics, digital transmissions, electronic bulletin boards (EBBs), distant databases, facsimile machines, video telephones, etc. These technologies seem to have the greatest potential in helping rural schools overcome the disadvantages of

remoteness and geographical isolation where shortages in specialized staff, low student enrollments, and small numbers of special needs students severely limit program offerings for students and staff development opportunities for teachers and administrators.

Defining Telecommunicated Distance Learning

Two significant features must be considered in any attempt to define telecommunicated distance learning -- distance education is both *time* and *distance* insensitive. Any definition would be incomplete without addressing both these factors. In this paper, we propose (1) a classroom-focused definition of telecommunicated distance education which is *distant* insensitive, and (2) a network-focused definition which is *time* insensitive.

Classroom-Focused Distance Learning

An accepted definition which is classroom-focused and is *distance insensitive* is the live, simultaneous transmission of a teacher's lessons from a host classroom or studio to multiple receive-site classrooms in distant locations. Two-way live communication in real time, whether audio or video between the teacher and students, permits the instruction to be interactive. This model implies that instruction is oriented more toward small groups or clusters of students at different sites than to an individual student. Under ideal conditions, students at any one site are not only provided direct contact with their instructor but are also able to communicate directly with students at other remote sites during the instructional process (Barker, Frisbie, and Patrick, 1989).

Network-Focused Distance Learning

This classroom-focused definition, though accurate in regards to the issue of *distance insensitivity* does not allow for flexibility in regards to *time* . This is true for both instructor and students. In today's global society, much learning and interactive communication can and does occur through the simple use of a standard microcomputer and modem at the convenience of the user. More than 5000 electronic databases and thousands of electronic bulletin boards (EBBs) are accessible online in the United States (*Directory of Online Databases*, 1993). These services, coupled with electronic mail (E-mail), permit individuals to gather information, keep current on virtually any topic of interest, and communicate with others across the country or around the world

at their own *time* convenience. Hence, any definition for distance learning must include more than just what we consider to be classroom-focused instruction. It must also include student initiated data gathering and interactive communication resulting in learning which is networked-focused. The potential for learning via telecommunications networks and/or E-mail exchange is incomprehensible. In fact, it is plausible that network-focused distance learning which is *time insensitive* --- coupled with the exponential growth of electronic databases, EBBs, and E-mail services -- will eclipse the practice of classroom-focused distance learning defined in the preceding paragraph.

The remainder of this paper presents a brief description of (1) classroom-focused distance education technologies and practice, and (2) network-focused distance learning technologies and practice.

Classroom-Focused Distance Learning Technologies and Applications

Distance learning in American classrooms received its legislative impetus when the United States Congress passed Public Law 100-297 in late 1988 allocating $100 million to create the federal Star Schools Program in support of distance learning efforts to benefit education (Withrow, 1990). Rural schools have been the biggest users of distance learning programs in order to help meet state-mandated curriculum requirements, to offer required courses for which a certified teacher is not available, or to provide inservice training in remote locations that might not otherwise be available. Distance learning programs of one type or another are now operative in all 50 states. Analog signal over satellite, microwave, slow-scan TV, and computer audiographics are the most common technologies currently in use in distance education programs (Barker, 1992). Rapid developments in compressed video technologies, however, using copper telephone lines and fiber optics are receiving increased attention by distance education experts.

Electronic Field Trips: Under the direction of a teacher, students use video telephones and facsimile machines over regular telephone lines to speak with and view students or nationally known experts in other parts of the nation and share printed and graphic materials. Electronic field trips have been widely used by rural schools in New York, Hawaii, Illinois, North Carolina, and

other states.

Audiographics: Microcomputer-aided audiographic teleteaching is a computer-networked distance learning system that incorporates computer-generated graphics that function much like an electronic chalkboard. Audiographics requires specially designed telecommunications software that allows the user to create computer graphics and multi-sized text called "slides" that can be transmitted in real time from one computer to another via regular telephone lines over long distances. The networked computers operate on a "common screen" basis. That is, the slide shown on the host computer monitor automatically appears on computer monitors at distant sites. Audio interaction between the host and distant site(s) is via a speaker telephone. Use of facsimile machines permits hard copy exchange of instructional handouts or student written work. Successful audiographic programs serving rural schools have been operated in Pennsylvania, Texas, Utah, New York, Alabama, Hawaii, South Dakota, Louisiana, and South Carolina (Neights, 1993).

Interactive Satellite TV Programs: Satellite delivered distance education has been the most widely accepted distance learning medium among rural schools. Kentucky has established its own statewide network. Large networks have been established in several other states including North Carolina, Illinois, Oklahoma, Washington, South Carolina, Missouri, and Texas.

Among the more noted program providers servicing predominantly rural schools are the TI-IN Network in San Antonio, Texas; the Satellite Telecommunications Educational Programming network in Spokane, Washington; the Arts and Sciences Teleconferencing network in Stillwater, Oklahoma; and the Satellite Education Resources Consortium based in South Carolina.

Live TV broadcasts are beamed from a host site classroom or studio via an up-link dish to a satellite transponder. The signal is then beamed back to down-link dishes at the various receiver site locations. A single satellite's "footprint" can cover one-third of the earth thereby permitting simultaneous transmission across the entire United States and most of Canada, and Mexico. In this configuration, satellite technology permits one-way transmission of voice, data, and full-motion video. Audio talk-back by participants at the receiver site locations is over regular

telephone lines.

On this basis of one-way video, two-way audio communication, the instruction is deemed interactive. By using the telephone at receiver site locations, students can call in questions and hear their instructor's response on the air. Students can both see and hear their instructor over the classroom television, but are unable to see or talk directly with students located at different sites without routing their calls through the host classroom/studio. The teacher cannot see students, but is able to respond to questions or comments whenever students call in on the telephone line.

Most distance learning satellite systems are also capable of electronic copy distribution to create hard copy handouts and exams sent via satellite directly to the receiver sites. In most of the satellite networks now in operation, a classroom facilitator who may be an aid, volunteer, or another teacher usually sites in with the students to operate the equipment, distribute materials, and otherwise provide assistance. Student home work assignments are typically routed through the U.S. postal service for the TV teacher's evaluation (Barker, 1991).

Two-Way Interactive Television Systems: Most two-way TV systems are locally controlled cooperatives made up of three to six schools linked together to electronically share human, financial, and equipment resources. Unlike the one-way video, two-way audio format common to satellite TV systems, in two-way interactive TV systems, the teacher in one location and students in distant locations can both see and hear each other during instruction. Not only are students able to interact with their TV teacher, they are also able to see, hear, and communicate freely with their TV classmates at different schools.

Technologies for transmitting two-way TV signals include low power television, microwave signal, fiber optics, co-axial cable and digital compression. Among the first rural schools to report success in working with two-way interactive TV systems were small networks in Minnesota, Illinois, Arizona, and Oklahoma (Barker, 1989; Followill and Andersen, 1991; Kitchen, 1987; Robinson, 1985). Interest and participation by rural schools in two-way interactive TV systems has grown rapidly in recent years making it difficult to accurately document all those that are currently in the planning stages or actually in operation.

Network-Focused Telecommunicated Learning Services

Two main services are provided to schools via telecommunications (sometimes referred to as data communications or videotext) -- (1) acquisition to large electronic databases and electronic bulletin boards, and (2) the opportunity for users to communicate by means of electronic mail (E-mail). Computer-based telecommunications can provide opportunities for teachers and for students that are simply not possible through traditional telephone or mail services. Through E-mail, teachers and students can easily converse on-line with many people whom they have never met before, but who share a common interest in practically any topic of study. In addition, they have access to all sorts of information, far surpassing what can be found at the school or local library and which is much more readily available than using interlibrary loan. For those with access to Internet, there exists the possibility of logging on to other computers around the world thereby entering new databases. In short, teachers and students can share ideas and access information and resources with a much broader community than would otherwise be imaginable.

It has been estimated that over 14,000 electronic databases are available to computer users in the United States (Thornburg, 1992) with more than 5000 available online (*Directory of Online Databases*, 1993). Advances in telecommunications have in recent years increased in efficiency a millionfold. For example, AT&T is now able to transmit data between Chicago and the East Coast at the rate of 6.6 gigabits per second (the equivalent of 1000 books). At this rate, the entire Library of Congress could be transmitted in just 24 hours. By contrast, using conventional copper wire and a 2400 baud modem, the same task would require almost 2000 years (Wriston, 1992).

Teachers and students skilled in telecommunications have available through the microcomputer, modem, and regular telephone lines the possibility of extending learning far beyond the walls of the traditional classroom. Furthermore, gathering information and/or communicating with others who share common interests becomes both time and distance insensitive. Electronic databases and electronic bulletin boards are accessed at the user's convenience. Likewise, E-mail messages are "opened" and responses sent according to the user's time schedule. The problem of telephone tag (trying to reach someone by telephone who is either

not at home or not in the office) becomes a mute issue. As a result of telecommunications, information and dialogue with others has no boundaries -- neither time nor place. Vast amounts of information as well as the opportunity to communicate with subject matter experts or students/teachers in other parts of the country or anywhere in the world is just a finger tip away.

In the same way that distance learning technologies have brought curriculum equity to rural students and increased staff development opportunities for rural teachers, telecommunications promises to remove the stigma of remoteness and geographical isolation. E-mail services, electronic databases, EBBs topics are available for students and educators at all grade levels and in virtually all subject areas. A few of those which have particular application to rural schools are ERIC/CRESS Online, National Distance Learning Center Online, America Tomorrow Leadership Information Service, the American Indian Science and Engineering Society network, SpecialNet, CLASSMATE and Classroom Instruction Program sponsored by DIALOG Information Services, U.S. government sponsored bulletin boards, numerous state-wide networks, etc. It should be understood that the databases, networks, and electronic bulletin boards reported in this short paper are certainly not exhaustive. Telecommunications is a data resource that is growing exponentially. New networks and new databases are continually opening to interested users at an increasingly rapid rate.

ERIC Services and ERIC/CRESS Online: The Educational Resources Information Center (ERIC) System is the largest electronic database in the world. With a working knowledge of how to use ERIC, students and teachers can gather information on about any topic in education they desire to investigate. ERIC is sponsored by the U.S. Department of Education and is designed to collect educational documents and make them available to teachers, administrators, students, and others interested in education. Thousands of documents, reports, proceedings, and articles have been collected and microfilmed and are easily accessible to interested users. Currently 16 ERIC clearinghouses collect, abstract, and microfiche 2600 documents each month for distribution to nearly 3000 repositories -- mostly college and university libraries.

Within the last five years, the ERIC index has been placed on CD-ROM. Interested

students and teachers can now search the entire database in a matter of seconds if they have access to a computer and the ERIC CD-ROM Silverplatter. The placement of ERIC indexes on CD-ROM has made it possible for public school libraries to provide ERIC searches on-site. Previously, ERIC users had to travel to the nearest college or university to gain access to ERIC. Furthermore, users who have access to Internet can search the ERIC CD-ROM Silverplatter online from their own school if they have a computer and modem.

The ERIC Clearinghouse on Rural Education and Small Schools (ERIC/CRESS) has been a database of information resources for rural and small schools since 1966. In late 1993, ERIC/CRESS announced plans to create the ERIC/CRESS Online network. The service is intended to serve chiefly rural schools and will offer free service accessible from anywhere in the United States. Initial plans include the following services: (1) downloadable ERIC/CRESS publications such as ERIC Digests and newsletter issues; (2) a searchable database of organizations focusing on rural education, American Indian education, and outdoor education; (3) free customized searches of the ERIC database by ERIC/CRESS staff members; (4) and online ordering of ERIC/CRESS printed publications (Not Just a Database, 1993). A toll-free number will be provided, thus allowing anyone to make use of ERIC/CRESS services provided they have a microcomputer and modem. Information on joining the ERIC/CRESS Online service can be obtained by contacting ERIC/CRESS, Appalachia Educational Laboratory, P.O. Box 1348, Charleston, West Virginia 25325 or call (800)-LET ERIC (583-3742).

National Distance Learning Center Online (NDLC): NDLC provides online searches 24 hours per day free of charge. The database offers information on distance learning programs and curriculum materials for K-12, higher education, continuing education, and general interest teleconferences. The NDLC database changes daily with the addition of new listings, new subject areas, and new providers. Through searching the database, teachers and students are able to investigate all sorts of materials (possible contacts for electronic field trips, videos, curriculum guides, computer software, etc.) to supplement or support traditional classroom instruction. In order to access the resources of NDLC, schools need only a computer and a 2400 baud modem.

No charge is assessed the schools except the long distance toll call. Readers interested in more information should contact NDLC, Owensboro Community College, 4800 New Hartford Road, Owensboro, Kentucky 42303; or call (502) 686-4556; Internet address: NDLC.OCC.UKY.EDU.

America Tomorrow Leadership Information Service (ATLIS): ATLIS is supported by America Tomorrow Incorporated, a Delaware Corporation founded in August 1991. ATLIS is an online computer network linking school leaders, business leaders, and community leaders to provide opportunities for decision makers to dialogue on issues and concerns affecting schools in local communities.

In addition to E-mail services among members, the network provides school leaders with a condensed source of news and information updated daily from a large number of national education organizations and business organizations including the Association for Teacher Educators, National Association of Elementary School Principals, National Association of Secondary School Principals, National Association of State Boards of Education, National Board for Professional Teaching Standards, National Community Education Association, National Council of Teachers of Mathematics, National Education Goals Panel, National Head Start Association, U.S. Department of Education, etc.

Specific services of ATLIS include: (1) an electronic news service from participating organizations; (2) an informational database containing calendar, resource, and information topics organized by association; (3) an issues and answers database dealing with trends and broad issues dealing with the educational, health, and social issues affecting learning; (4) a topically organized bulletin board that lets users initiate and participate in discussions on topics raised by ATLIS members; and (4) opportunity for E-mail communication by ATLIS members across the network (Tsantis, 1993).

Principals in rural schools who join the ATLIS network become linked via E-mail to dialogue with counterparts across the country to address issues and problems of mutual concern. In addition, they are connected to a wealth of information provided by national education and business organizations. The annual membership fee to join the network is less than $200.

Readers interested in more information should contact America Tomorrow Inc., P.O. Box 2310, Bethesda, Maryland 20827-2310; or call (800) 456-8881.

American Indian Science and Engineering Society Electronic Network (AISESnet) : American Indians make up a large segment of the American population living in rural areas. AISESnet serves as an informal means for distributing information to AISES members, chapters, high school students, Indian reservations, and members of industry. To join AISESnet, users must have an Internet account. AISESnet users enjoy the benefits of E-mail and are able to access a database of AISES news and information, calendar of events, chapter newsletters, etc. Readers interested in more information should contact the Department of Native American Studies, 600 University Avenue, University of Montana, Missoula, Montana 59812; or call (406) 243-5733.

SpecialNet: The services provided by SpecialNet are offered through GTE Educational Network Services. SpecialNet has been in operation since 1981 and has since expanded in both services and users. Every state office of education is a subscriber as well as many local education agencies in each of the 50 states. SpecialNet is a gateway to specialized databases, E-mail between subscribers, and electronic bulletin boards (EBBs). Some of the databases accessible through SpecialNet are those dealing with early childhood education, children with special needs and their families, individuals with disabilities, special education law, employment opportunities in education, promising educational practices, recruitment and retention of teachers, etc.

A large number of EBBs focusing on both general education and human services items as well as special education can also be accessed by network subscribers. Each bulletin board is managed by subject matter experts. A sampling of EBBs in general education and human services includes those covering topics such as AIDS, upcoming educational conferences, national statistics on education, litigation, computer applications and software, etc. Topical bulletin boards addressing special education issues include assistive devices, news from the Council of Administrators of Special Education, behavior disorders/emotional disturbance, news from the Council for Exceptional Children, early childhood education and children with special needs,

learning disabled children, deaf education, and many more. As with other telecommunications services, access to SpecialNet services requires a microcomputer, a modem, telecommunications software, and regular telephone lines. Readers interested in more information about SpecialNet services and subscription fees should contact GTE Educational Network Services at (800) 927-3000.

CLASSMATE and Classroom Instruction Program: Two separate electronic database resources offered by DIALOG Information Services are CLASSMATE and the Classroom Instruction Program (CIP). Both have been designed for use by students in conducting research activities assigned by classroom teachers. CLASSMATE is a menu-driven resource of 120 different databases intended for students in K-12. CIP is a more extensive resource comprised of some 350 separate databases intended for students in grades 9-12. There is no sign-up fee or annual subscription cost to use either CLASSMATE or CIP, however, connect charges of 25 cents per minute or $15.00 per hour are assessed users. As with other electronic databases, the only equipment items required to connect to either resource is a microcomputer, modem, telecommunications software, and regular telephone lines. Readers interested in learning more about either CLASSMATE or CIP should contact DIALOG Information Services, 3460 Hillview Avenue, Palo Alto, California 94304 or call (800) 334-2564.

State-wide Networks and Government Sponsored Bulletin Boards: Several states have taken the lead to establish state-wide telecommunications networks serving schools in their jurisdiction. Others are in the planning stages to establish such networks. The Florida Information Resources Network connects data centers and computer resources at universities, junior colleges, and public schools throughout Florida. E-mail is also provided for all network users. Teachers and students in schools throughout the state can retrieve information from remote databases, download teachers' guides, capture images of satellite weather, as well as participate via E-mail in "electronic conferences" of common interest (Barron and Ivers, 1993). Big Sky Telegraph, sponsored by Western Montana College provides a similar service to teachers and students throughout Montana, including Montana's 114 remaining one-room schools (Morton,

1993). TENET in Texas and ILLINET in Illinois are other examples.

More than 100 highly specialized EBBs sponsored by the federal government can be accessed over regular telephone lines by anyone with a computer, modem, and communications software (Nyberg, 1993). Most are reached by long-distance toll calls, a few by toll-free 800 numbers and some via Internet. Federally supported EBBs cover essentially the full range of government departments (from agriculture to veteran affairs) and offer a constantly updated assortment of government information including reports, statistics, software, and graphics.

The growth of telecommunications networks and bulletin boards in both the private and public sector is advancing so rapidly that it is virtually impossible to keep abreast of all the new ones as they become available. For this reason, readers who are interested in learning more about specific telecommunications networks or electronic bulletin board services are encouraged to contact the technology department in their state office of education. Educational technology specialists at the state level should be knowledgeable about specific services and their potential for local use.

The Potential of Internet as a Telecommunications Resource for K-12 Schools: Clearly the most widespread of all telecommunications networks is the Internet. Internet is a global "network of networks" located all over the world. The total number of computers and users connected to Internet is estimated between four and five million (Descy, 1993). At present, government agencies, colleges and universities, and the U.S. military are the major users of Internet. While K-12 connections to Internet are in their infancy, in the near future, it is anticipated that Internet connections among K-12 schools will proliferate dramatically (Howley, 1992). Future plans include expanding Internet services to K-12 schools and to public libraries thereby creating a national network for research in education. The goal in connecting K-12 schools to Internet services is very simple.

> Electronic connections will become as commonplace as telephone connections. Every school, every home, and every office will be wired electronically. The electronic infrastructure is being built now, and at some future time schools, homes, and businesses will be able to download text, still images, and audio and video products. . . Internet service providers [will] reach the K-12 audience. Dramatic developments are likely in the 1990s. (Howley, 1992, p. 2).

Internet is used for E-mail between individuals and groups, remote login to other computers to search their databases, and file transfer from one Internet computer to another. Those connected to Internet have free access to hundreds of library catalogs across the country and around the world. They can also freely participate in thousands of special interest groups via E-mail and download thousands of computer software programs and full-text documents.

Conclusion

Improvements in telecommunications have made it increasingly easy to transmit instruction, access information, and share electronic messages over geographically forbidding distances. The growth and interest in distance learning technologies are advancing at a rapid rate, whether they be classroom-focused or network-focused applications. Current practice clearly demonstrates that successful programs and applications are varied. There does not appear to be one best method or approach for distance education. New and advancing technologies are reaching out to diverse audiences providing increased opportunities for education and communication. The benefit to rural schools is obvious. The traditional barriers of remoteness and geographical isolation are bridged by today's telecommunication technologies. It remains for educators and community leaders in rural areas to find ways to make these resources a part of their school's educational program.

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